

What is claimed is:

1. An electrical power generator comprising:

a) a water vapor generator;

5 b) a hydrogen gas generator attached to the water vapor generator, said hydrogen generator containing a substantially non-fluid substance which reacts with water vapor to generate hydrogen gas; said hydrogen generator optionally being attached to said water vapor generator via at least one conduit; and
c) a fuel cell attached to the hydrogen gas generator; said fuel cell optionally being attached to said hydrogen gas generator via at least one conduit.

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2. The power generator of claim 1 further comprising at least one conduit connecting the water vapor generator to the hydrogen gas generator and at least one conduit connecting the generator to the fuel cell.

15 3. The power generator of claim 1 further comprising a return line which directs residual water vapor and hydrogen gas from the fuel cell to the water vapor generator.

20 4. The power generator of claim 1 wherein the water vapor generator comprises a chamber at least partially filled with water.

5. The power generator of claim 1 wherein the water vapor generator comprises a chamber at least partially filled with a mixture of water and alcohol.

25 6. The power generator of claim 1 wherein the water vapor generator comprises a chamber at least partially filled with water vapor.

7. The power generator of claim 1 wherein the water vapor generator is at least partially filled with ice.

5 8. The power generator of claim 1 wherein the hydrogen gas generator comprises a chamber at least partially filled with a substantially non-fluid substance which reacts with water vapor to generate hydrogen gas.

9. The power generator of claim 1 wherein the hydrogen gas generator comprises a chamber at least partially filled with a substantially non-fluid substance which
10 reacts with a mixture of alcohol and water vapor to generate hydrogen gas.

10. The power generator of claim 1 further comprising hydrogen gas initially loaded within at least one of said water vapor generator, hydrogen gas generator, fuel cell and said optional conduits.

15 11. The power generator of claim 1 further comprising at least one device attached to at least one of said water vapor generator, said hydrogen generator or said fuel cell for causing an initial flow of water vapor from the water vapor generator to the hydrogen gas generator.

20 12. The power generator of claim 1 wherein said substantially non-fluid substance comprises a material selected from the group consisting of alkali metals, calcium hydride, lithium hydride, lithium aluminum hydride, $B_{10}H_{14}$, sodium borohydride, lithium borohydride and combinations thereof.

25 13. The power generator of claim 1 wherein said substantially non-fluid substance comprises sodium borohydride.

14. The power generator of claim 1 wherein said substantially non-fluid substance comprises lithium borohydride.
15. The power generator of claim 1 wherein said substantially non-fluid substance comprises lithium aluminum hydride.
16. The power generator of claim 1 further comprising a hydrogen generation catalyst combined with said substantially non-fluid substance.
17. The power generator of claim 16 wherein said catalyst is selected from the group consisting of cobalt, nickel, ruthenium and alloys and combinations thereof.
18. The power generator of claim 1 further comprising at least one pump for pumping hydrogen gas and water vapor between the water vapor generator and the fuel cell.
19. The power generator of claim 18 wherein the at least one pump comprises a mesopump.
20. The power generator of claim 1 further comprising at least one valve for regulating the passage of water vapor between the water vapor generator and the hydrogen gas generator.
21. The power generator of claim 20 wherein the at least one valve comprises a mesovalve.
22. The power generator of claim 20 wherein the at least one valve is controlled by gas pressure within the power generator.

23. The power generator of claim 20 wherein the at least one valve regulates gas pressure within the power generator.
- 5 24. The power generator of claim 1 further comprising porous plugs adjacent to said water vapor generator, said plugs substantially impeding the flow of liquid water from said water vapor generator and substantially allowing the flow of hydrogen gas and water vapor into and out of said water vapor generator.
- 10 25. The power generator of claim 1 wherein said substantially non-fluid substance is in powder, granule or pellet form.
26. The power generator of claim 1 wherein said fuel cell is at least partially surrounded by a thermal insulator.
- 15 27. The power generator of claim 1 further comprising a heater adjacent to the fuel cell.
28. The power generator of claim 1 further comprising a tensile membrane within
20 the water vapor generator which exerts pressure directing water vapor from the water vapor generator to the hydrogen gas generator.
29. The power generator of claim 1 wherein the water vapor generator, the hydrogen gas generator, said fuel cell and said optional conduits are formed
25 within a polymeric block.
30. The power generator of claim 29 wherein the polymeric block comprises a polyethylene, a polyimide, a polycarbonate, an acrylic, or combinations thereof.

31. A process for generating hydrogen gas for fueling a fuel cell comprising:
a) directing water vapor from a water vapor generator to a hydrogen generator,
said hydrogen generator being at least partially filled with a substantially non-
5 fluid substance which reacts with water vapor to generate hydrogen gas; and
b) directing said hydrogen gas and any residual water vapor to a fuel cell.
32. The process of claim 31 wherein a mixture of water vapor and alcohol vapor
are directed to the hydrogen generator.
- 10 33. The process of claim 31 further comprising:
c) directing any residual water vapor and any residual hydrogen gas from the fuel
cell back to the water vapor generator.
- 15 34. The process of claim 31 further comprising directing water vapor and any
present hydrogen gas from the water vapor generator to the hydrogen generator
via at least one conduit, and directing hydrogen gas and any residual water vapor
from the hydrogen gas generator to the fuel cell via at least one conduit.
- 20 35. The process of claim 31 further comprising directing water vapor and any
present hydrogen gas from the water vapor generator to the hydrogen generator
via at least one conduit, and directing said hydrogen gas and any residual water
vapor to the fuel cell via at least one conduit; and returning any residual water
vapor and any residual hydrogen gas from the fuel cell to the water vapor
25 generator via at least one return line.
36. The process of claim 31 wherein the water vapor generator comprises a
chamber at least partially filled with water vapor.

37. The process of claim 31 wherein the passage of said water vapor from the water vapor generator to the hydrogen generator is controlled by at least one valve.
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38. The process of claim 37 which valve is valve controlled by the pressure of said hydrogen gas.
39. The process of claim 31 wherein said substantially non-fluid substance
- 10 comprises a material selected from the group consisting of alkali metals, calcium hydride, lithium hydride, lithium aluminum hydride, sodium borohydride, lithium borohydride, and combinations thereof.
40. The process of claim 31 wherein said substantially non-fluid substance
- 15 comprises lithium borohydride.
41. The process of claim 31 wherein said substantially non-fluid substance comprises sodium borohydride.
42. The process of claim 31 wherein said substantially non-fluid substance
- 20 comprises lithium aluminum hydride.
43. The process of claim 31 wherein said substantially non-fluid substance is in powder, pellet or granule form.
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44. The process of claim 31 further comprising pumping said water vapor and any present hydrogen from said water vapor generator to said hydrogen gas generator.

45. The process of claim 44 wherein the pumping is conducted with a mesopump.

46. The process of claim 31 further comprising heating said fuel cell with a
5 heater.

47. The process of claim 31 comprising directing water vapor from the water
vapor generator to the hydrogen gas generator by pressure from a tensile
membrane within the water vapor generator.

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48. The process of claim 31 further comprising causing an initial flow of water
vapor from the water vapor generator to the hydrogen gas generator via at least
one device attached to, at least one of said water vapor generator, said hydrogen
generator or said fuel cell.

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49. In an improved process for generating electrical energy wherein water and
hydrogen gas are directed from a water containing chamber to a fuel cell; and
water and any residual hydrogen gas are directed from the fuel cell back to the
water containing chamber; and water and hydrogen gas are directed through a
20 hydrogen gas generator, which hydrogen gas generator is connected to each of the
fuel cell and water containing chamber and which hydrogen gas generator is at
least partially filled with a substance which reacts with water to generate
hydrogen gas, wherein the improvement comprises contacting water in the form
of water vapor with a substantially non-fluid substance which reacts with water
25 vapor to generate hydrogen gas.

50. The process of claim 49 wherein said substantially non-fluid substance
comprises lithium borohydride.

51. The process of claim 49 wherein said substantially non-fluid substance comprises sodium borohydride.

5 52. The process of claim 49 wherein said substantially non-fluid substance comprises lithium aluminum hydride.

53. A hydrogen gas generating apparatus, the apparatus comprising a housing which encloses:

- 10 a) a water vapor generator;
- b) a hydrogen gas generator, comprising a substantially non-fluid substance that reacts with water vapor to generate hydrogen gas;
- c) at least one conduit connecting the water vapor generator and the hydrogen gas generator, the conduit allowing for the flow of water vapor from the water vapor
- 15 generator to the hydrogen gas generator; and
- d) a valve positioned through said conduit for alternately opening and closing the conduit, said valve comprising:
 - i) a flexible diaphragm having a periphery that is fixed to said housing;
 - ii) a valve disc positioned opposite the diaphragm and mating with the
 - 20 conduit for alternately opening and closing the conduit;
 - iii) a rod connector having opposite ends, the rod extending through a portion of the conduit and attached at one of its ends to the diaphragm and attached at its opposite end to the valve disc; and
 - iv) a seal attached around a periphery of the conduit and positioned for
 - 25 mating with the valve disc when the valve disk is positioned to close the conduit.

54. The hydrogen gas generating apparatus of claim 53 which further comprises a fuel cell connected to the housing in a manner allowing for the flow of generated hydrogen gas into said fuel cell.